

Claims

1. A method for stimulating an immune response in a subject, comprising:  
administering to a subject exposed to an antigen an effective amount for inducing a  
synergistic antigen specific immune response of an immunopotentiating cytokine and an  
immunostimulatory CpG oligonucleotide having a sequence including at least the following  
formula:



wherein the oligonucleotide includes at least 8 nucleotides wherein C and G are unmethylated  
and wherein  $X_1$  and  $X_2$  are nucleotides.

2. The method of claim 1, wherein the cytokine is selected from the group consisting  
of GM-CSF, IL-3, IL-5, IL-12, and interferon- $\gamma$ .

3. The method of claim 1, wherein the immunopotentiating cytokine is an antigen-  
cytokine fusion protein.

4. The method of claim 3, wherein the antigen-cytokine fusion protein is an antigen-  
GM-CSF fusion protein.

5. The method of claim 1, wherein the antigen is a selected from the group consisting  
of a tumor antigen, a microbial antigen, and an allergen.

6. The method of claim 5, wherein the antigen is a tumor antigen.

7. The method of claim 1, wherein the antigen is administered to the subject in  
conjunction with the immunostimulatory CpG oligonucleotide and the immunopotentiating  
cytokine.

8. The method of claim 1, wherein the subject is passively exposed to the antigen.

9. The method of claim 1, wherein the subject has a neoplastic disorder.

10. The method of claim 1, wherein the subject has a viral infection.

11. A composition, comprising:

an effective amount for synergistically activating a dendritic cell of an

immunostimulatory CpG oligonucleotide having a sequence including at least the following formula:



wherein the oligonucleotide includes at least 8 nucleotides wherein C and G are unmethylated and wherein  $X_1$  and  $X_2$  are nucleotides; and

a cytokine selected from the group consisting of GM-CSF, IL-4, TNF $\alpha$ , Flt3 ligand, and IL-3.

11. The composition of claim 10, wherein the cytokine is GM-CSF.

12. The composition of claim 10, further comprising an antigen.

13. The composition of claim 12, wherein the antigen is selected from the group consisting of a cancer antigen, a microbial antigen, and an allergen.

14. A method for activating a dendritic cell, comprising:

contacting a dendritic cell exposed to an antigen with an effective amount for synergistically activating a dendritic cell of an immunopotentiating cytokine and an immunostimulatory CpG oligonucleotide having a sequence including at least the following formula:



wherein the oligonucleotide includes at least 8 nucleotides wherein C and G are unmethylated and wherein  $X_1$  and  $X_2$  are nucleotides.

15. The method of claim 14, wherein the cytokine is selected from the group consisting of GM-CSF, IL-3, IL-5, IL-12, and interferon- $\gamma$ .

16. The method of claim 14, wherein the antigen is a tumor antigen.

17. A method for treating a subject having a neoplastic disorder, comprising:  
administering to the tumor of a subject having a neoplastic disorder an  
immunopotentiating cytokine and an immunostimulatory CpG oligonucleotide having a  
sequence including at least the following formula:



wherein the oligonucleotide includes at least 8 nucleotides wherein C and G are unmethylated  
and wherein  $X_1$  and  $X_2$  are nucleotides, in an amount effective for synergistically increasing  
survival time of the subject with respect to a subject administered the immunostimulatory  
CpG oligonucleotide or the immunopotentiating cytokine alone.

18. The method of claim 17, wherein the tumor is selected from the group consisting  
of a tumor of the brain, lung, ovary, breast, prostate, colon, skin, and blood.

19. The method of claim 17, wherein the immunostimulatory CpG oligonucleotide  
and the immunopotentiating cytokine are injected directly into the tumor.

20. A contraceptive method, comprising:  
administering to a subject an antigen, an immunopotentiating cytokine and an  
immunostimulatory CpG oligonucleotide having a sequence including at least the following  
formula:



wherein the oligonucleotide includes at least 8 nucleotides wherein C and G are unmethylated  
and wherein  $X_1$  and  $X_2$  are nucleotides, wherein the antigen is an antigen selected from the  
group consisting of a gonadal cell antigen and an antigen from a cytokine or hormone required  
for the maintenance of a gonadal cell.